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ENGINEERING SUPPORT TO NMC IN DEVELOPMENT OF MANAGEMENT SYSTEMS FOR AERIAL TARGETS

Volume II: Cost Effectiveness of Aerial Target Accident/Incident Investigations

June 1974

Prepared for

U.S. NAVAL MISSILE CENTER
Pt. Mugu, Calif.

Under Contract F09603-73-A-4392
Task Order 0005

Publication W4-1055-TN02

Special Projects Branch
ARINC RESEARCH CORPORATION
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FOREWORD

This report describes support services provided by ARINC Research Corporation to the U.S. Naval Missile Center, Pt. Mugu, Calif., relating to the Engineering Management Information System being developed by NAVMISCEN for aerial target systems. Results of specific tasks conducted by ARINC Research are discussed in two volumes:

- Volume I – Development of Functional Block Diagram for Aerial Target Status Summary Model
- Volume II – Cost Effectiveness of Aerial Target Accident/Incident Investigations

Each volume describes the approach taken in the particular study discussed, presents results and conclusions, and offers recommendations where appropriate.

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ILLUSTRATIONS AND TABLES

1
INTRODUCTION AND SUMMARY

In accordance with Subtask II of Contract F09603-73-A-4392, ARINC Research conducted a study for the Naval Missile Center/Pt. Mugu to determine whether the cost associated with formal investigation of accidents or incidents resulting in losses of aerial targets is warranted.

Two basic types of information were obtained for this study: Air Force accident/incident data for target drones, from the data bank at Norton Air Force Base; and operational/maintenance records of two Navy activities, ~~(VC-3 and~~ Code 5500 of NAVMISCEN). The Air Force data were used, in the absence of equivalent Navy data, to generate estimates of the cost effectiveness of aerial-target accident/incident investigations. The Navy data were used to establish the conditions under which the Air Force data are directly applicable; to provide loss rates as inputs to the cost calculations; and to aid in determining if information to support accident/incident investigations is presently available in the Navy.

Results of this study provide evidence that formal investigation of target losses will identify cost-effective corrective actions. The study indicates a potential savings to the Navy of approximately $6 million over a 5-year period through the implementation of a one-year program of investigation similar to the one now in use by the Air Force. Recommendations for implementing such a program are presented in this report.

2
TECHNICAL APPROACH AND STUDY RESULTS

2.1 GENERAL

The approach taken in this study was to estimate the cost benefits to the Navy of incorporating aerial-target corrective actions, based upon analysis of problems identified from Air Force accident/incident data covering the past year. Potential benefits to the Navy were estimated by extrapolating the Air Force data into the Navy inventory of BQM-34As over the next 5-year period, assuming utilization rates equal to those experienced by the Navy during fiscal year 1973.

Since Navy Instruction 3760.J specifically excludes targets from formal accident investigation, Navy data regarding specific corrective actions are limited to local non-standard investigations. Such data as were obtainable were insufficient to be useful in this study, even for purposes of correlation or comparison with Air Force data. However, ARINC Research did obtain sufficient data from NAVMISCEN concerning the Navy's utilization of the AQM-34A and AQM-34E to provide a scenario for a cost-benefit analysis of Navy target investigations similar to those now conducted by the Air Force. The conclusions reached in this report therefore apply strictly to the BQM-34A, the BQM-34E, and the MQM-74 models adapted for the Integrated Target Command System (ITCS). Application to all other target models can only be inferred.

Navy operational and maintenance records were reviewed from the standpoint of their adequacy in supporting the types of accident/incident investigations conducted by the Air Force. This would require knowledge of basic flight parameters, command states, and configuration/maintenance history sufficient to isolate a problem to a correctable profile. The more detailed the data, the higher the resolution in assigning probable problem cause, and thus the higher the probability of initiating a valid corrective action. The Navy data were found to be generally satisfactory for this purpose, i.e.,

a. Operational records for the BQM-34 series targets appear to be as complete for Navy utilization as for Air Force operations. The MQM-74 series of targets, however, has no counterpart in the Air Force. These targets do not have telemetry in their present configuration, but will with

the integration of ITCS. Further, when supporting a flight with only the AN/MSQ-5 magnetic tape, recordings of the telemetry may not be available.

b. Maintenance records at the two Navy squadron locations visited by ARINC Research were found to be more than adequate for all target models currently operated by the Navy. All actions on target vehicles were found to be under positive control of a job number, and serial accountability was maintained regardless of equipment level.

Navy operational data for the BQM-34A and -34E, showing total flights and losses during FY 73 and the first six months of FY 74, are summarized in Table 1.

TABLE 1. NAVY OPERATIONAL EXPERIENCE WITH BQM-34A AND BQM-34E

Target Type	Flights		Losses (FY 73)			Losses (1st 6 Mo. of FY 74)		
	FY 73	FY 74*	Total	Hits	Op'l	Total	Hits	Op'l
BQM-34A	338	173	109	63	46	(Data Unavailable)		
BQM-34E	---	19	11	6	5	9	2	7
*First six months.								

Upon request of NAVMISCEN, Code AFISC/SER at Norton Air Force Base permitted ARINC Research to obtain complete historical records on accident/incident investigations of Air Force targets. Some 107 reports were obtained, covering approximate 5 years of Air Force target utilization. (The reports were "sanitized" to remove the dates and locations of the incidents, but this sanitizing process removed no essential data needed for this study.) From the Air Force data obtained, certain parameters were assessed for each accident/incident case considered. These parameters and their ranges are defined in Table 2.

The four most recent incidents covered in the Air Force data are for the BQM-34F, a target similar to the Navy's BQM-34E. A primary difference between the two types is in the recovery system: the Air Force version is designed for midair recovery (MARS), while the Navy version is for surface only. The remaining 103 Air Force records cover the BQM-34A, which is essentially identical to the Navy's BQM-34A. Except for the effects of minor differences in operational employment

TABLE 2. PARAMETERS FOR ASSESSMENT OF AIR FORCE TARGET ACCIDENT/INCIDENT RECORDS

Key	Parameter	Range
1.	Probable Causative Subsystem	C = Command, F = Flight Control, L = Launch, P = Propulsion, R = Recovery, S = Support
2.	Causative Factors	A = Administrative, D = Data, De = Design Deficiency, E = Environment, M = Maintenance, P = Personnel, Q = Quality, U = Unknown
3.	Probability of Isolation to True Cause	0 = No confidence in isolation, 1 = Certain isolation
4.	Cost of Incident/Accident	Thousands of dollars
5.	Probability of Recurrence Given No Corrective Action	0 = Never recur, 1 = Certain to recur next flight
6.	Estimated Nonrecurring Cost of Corrective Action	$0 = Simple change in procedure; $X = One-time cost of corrective action program; a = Avoidance type of corrective action; d = Design modification type of corrective action; NA = Non-applicable (e.g., because of inability to control causative factor)
7.	Estimated Recurring Cost of Corrective Action	$0 = Retraining only involved; $Y = Cost per target for ECP, including installation; a and d as defined above; p = Procedural-change type of corrective action
8.	Direct Manhours Spent in Investigation	Ranges from 60 manhours for routine incident investigation (note 1) to 500 manhours for most extensive accident-team investigation (note 2)

Note 1: Value obtained from Air Force safety officer responsible for investigations at Tyndall AFB.
Note 2: Value estimated from review of Air Force accident reports.

between the Air Force and the Navy use of the -34A, which will be discussed later, the Air Force data base is considered an excellent source for this study.

2.2 COST MODELS

ARINC Research developed an equation (see Figure 1) that could utilize Air Force accident/incident data to compute estimates of potential cost savings per

$$\begin{pmatrix}\text{Estimated}\\\text{Savings per}\\\text{Vehicle}\end{pmatrix}=\underbrace{\begin{pmatrix}\text{Probability}\\\text{that Cause}\\\text{was Real}\end{pmatrix}_{\#3}\begin{pmatrix}\text{Estimated}\\\text{Cost of}\\\text{Occurrence}\end{pmatrix}_{\#4}\begin{pmatrix}\text{Estimated}\\\text{Probability}\\\text{of Occurrence}\end{pmatrix}_{\#5}}_{\text{Item No., Table 2}}\begin{pmatrix}\text{Recoveries}\\\text{per Drone}\end{pmatrix}^{*}$$

*One less than the average number of flights per drone; see Table 3.

Figure 1. Model of Expected Cost Savings per Target Vehicle Due to Each Cause Identified Through Investigation

vehicle that could be realized by specific corrective actions. The first three terms on the right-hand side of that equation correspond to parameters 3 through 5 of Table 2. The last term in the equation represents one less than the average number of flights per drone, as calculated from the Navy operational data presented in Table 1.

This equation is conservative in several ways. First, it is based on the assumption that the accident/incident would result in additional costs due to repair or loss of vehicles only on those flights which would have been recovered had the malfunction not occurred. Thus it does not include additional costs which might be incurred if a malfunction occurs early enough in flight to cause an abort. Second, the equation assumes that recoveries per drone remains constant. Therefore it does not include the increase in recoveries per drone which might result from improvements that decrease the loss rate of the system.

To extrapolate the Air Force data into net savings per corrective action over a five-year operating period, a second equation (Figure 2) was developed to include: 1) the expected savings per vehicle (from the Figure 1 equation); 2) nonrecurring and recurring investment costs for each vehicle (Table 4); and 3) total number of vehicles expended during the five-year operational period (Table 3).

$$\begin{pmatrix}\text{Net Savings Due to}\\\text{Corrective Action}\\\text{Resulting from } j^{th}\\\text{Incident Over Five}\\\text{Years of Subsequent}\\\text{Operations}\end{pmatrix}=\left\{\begin{pmatrix}\text{Expected Savings}\\\text{per Vehicle}\end{pmatrix}_j-\begin{pmatrix}\text{Estimated Mod}\\\text{Cost per Vehicle}\end{pmatrix}_j\right\}\begin{pmatrix}\text{Total Number of}\\\text{Vehicles Expended}\\\text{in Five Years}\end{pmatrix}-\begin{pmatrix}\text{Estimated Non-}\\\text{recurring Cost to}\\\text{Implement Change}\end{pmatrix}_j$$

Where "Expected Savings per Vehicle" is the estimated cost per vehicle for the failure mechanism eliminated (Figure 1);

"Estimated Mod Cost per Vehicle" and "Estimated Nonrecurring Cost to Implement Change" are engineering estimates (ARINC Research).

Figure 2. Model of Expected Cost Savings Due to Corrective Action Implementation

TABLE 3. OPERATIONAL DATA ASSUMED FOR
COST VS. BENEFIT ANALYSIS

Date Element	Target Type	
	BQM-34A	BQM-34E
a. Monthly Rates		
Flights	28	4
Flights/Operational Loss	7.4	5.6
Flights/Kill Loss	5.4	8.4
Flights/Loss (Any)	3.1	3.4
Recoveries/Drone	2.1	2.4
b. Projected Five-Year Totals		
Flights	1,680	240
Operational Losses	227	43
Kill Losses	311	28
All Losses	538	71
Total Non-Loss Flights	1,142	169

2.3 SUMMARY OF AIR FORCE DATA

The above-referenced Table 4 contains Air Force accident/incident data covering approximately the past year of flights of the subject target types. For this analysis, certain data entries of that table were disregarded or combined. These include:

a. Columns 1-4. Consideration of the first four columns, representing the BQM-34F, shows an overwhelming positive influence on the cost benefit analysis. This is because of the small investment required in an avoidance type of corrective action to prevent a recurrence of the loss of the target and recovery aircraft. Owing to the small sample of BQM-34Fs and the difference in configuration relative to the -34A, it was decided to avoid this overriding influence; accordingly, the four columns representing the BQM-34F were eliminated from further consideration.

b. Columns 5, 7, 10, 19 and 23 were omitted from further analysis because the cause of each of these incidents or accidents was judged to be beyond the scope of control with regard to the implementation of corrective action.

TABLE 4. SUMMARY OF AIR FORCE ACCIDENT/INCIDENT DATA FOR AERIAL TARGETS

Item Number ►	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Incident (I) or Accident (A) ►	I	I	A	A	A	I	A	I	A	I	A	I	I	I
BQM-34 Type ►	F	F	F	F	A	A	A	A	A	A	A	A	A	A
(A) Probable Causative Subsystem	R		R	R	C	P	L	L	R	R	S	R	R	R
(B) Causative Factor	D	P	D, De	D/Q	U	D/Q	Q	A/P	P	E	P/E	E, D	E, D	Q
(C) Probability of Isolation to True Cause	1.0	1.0	1.0	0.5	0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
(D) Cost of Incident/ Accident	0	5K	2M	500K	75K	10K	75K	15K	75K	1K	75K	6K	6K	1K
(E) Prob. of Recurrence Without Correction	.01	.01	.01	.01	.01	.05	.01	.01	.005	.005	.05	.05	.05	.001
(F) Nonrecurring Cost of Corrective Action	1M	25K	25K[a]	1K[a]	NA	10K	NA	2K	2K	NA	1K[a] 5K[d]	1K[a]	1K[a]	1K
(G) Recurring Cost of Corrective Action	1K	0	0	0	NA	1K	NA	100	100	NA	0[a] 0[d]	0[a]	0[a]	10
(H) Direct Manhours Spent in Investigation	60	60	500	250	200	60	200	60	200	60	200	60	60	60
(I) Cost Benefit Positive?	N	N	Y	Y	-	Y	-	Y	Y	-	Y[a] Y[d]	Y	Y	N

Item Number ►	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Incident (I) or Accident (A) ►	I	I	I	I	A	A	I	A	I	A	I	A	I	A
BQM-34 Type ►	A	A	A	A	A	A	A	A	A	A	A	A	A	A
(A) Probable Causative Subsystem	R	R	R	P	L	R	R	S, C	R	C, P	R	R	R	R
(B) Causative Factor	P	E, D, Q	D, E	M	P, M	P, Q	E	D, P	E	D, P	D	D, Q	E, D	E, D
(C) Probability of Isolation to True Cause	1.0	1.0	1.0	0.5	0.2	0.7	1.0	0.7	0.7	0.5	1.0	0.2	1.0	1.0
(D) Cost of Incident/ Accident	5K	5K	10K	5K	100K	100K	1K	100K	5K	100K	10K	100K	3K	100K
(E) Prob. of Recurrence Without Correction	.01	.001	.05	.01	.01	.005	.05	.005	.01	.005	.002	.001	.02	.02
(F) Nonrecurring Cost of Corrective Action	500	1K[a] 1M	1K[a] 1M	50K	NA	2K	1K[a]	2K	NA	2K[a] 50K[p] 500K[d]	25K	100K	2K[a] 1M[d]	1M
(G) Recurring Cost of Corrective Action	0	0[a] 2K	0[a] 2K	100	NA	0	0[a]	0	NA	0[a] 1K[p] 0[d]	500	100	0[a] 5K[d]	5K
(H) Direct Manhours Spent in Investigation	60	60	60	60	60	300	60	350	60	500	80	400	60	200
(I) Cost Benefit Positive?	Y	Y[a] N[d]	Y[a] N[d]	N	-	Y	Y	Y	-	Y[a] N[p]	N	N	Y[a] N[d]	N

KEY:

Row (A) : C = Command, F = Flight Control, L = Launch, P = Propulsion, R = Recovery, S = Support

Row (B) : A = Administrative, D = Data, De = Design Deficiency, E = Environment, M = Maintenance, P = Personnel, Q = Quality, U = Unknown

Row (C) : 0 = No confidence in isolation, 1 = Certain isolation

Row (D) : Thousands of dollars

Row (E) : 0 = Never recur, 1 = Certain to recur next flight

Row (F) : \$0 = Simple change in procedure; \$X = One-time cost of corrective action program; a = Avoidance type of corrective action; d = Design modification type of corrective action; NA = Non-applicable (e.g., because of inability to control causative factor)

Row (G) : \$0 = Retraining only involved; \$Y = Cost per target for ECP, including installation; a and d as defined above; p = Procedural-change type of corrective action

Row (H) : Ranges from 60 manhours for routine incident investigation to 600 manhours for most extensive accident-team investigation

Row (I) : Y = Yes; N = No; a, d, p as defined above

c. <u>Column 12.</u> The corrective action identified for column 12, if implemented in a timely manner, would have prevented the accidents represented in columns 13 and 17. Therefore the cost of corrective action for these three accidents was considered only once in the analysis.

Note in Table 4 that some of the columns have dual entires in the corrective-action cost estimates. The reason is that two types of corrective action could be implemented in some cases. These generally involve 1) procedural changes, and 2) design modifications incorporated through field-installed kits. Procedural changes are also referred to as an "avoidance modification" — a change to operating procedures or ground rules so as to simply avoid the problem. This might, for example, be a decision to abort a flight prior to launch based on some non-normal circumstances at the time. It is recognized that in a critical T&E presentation, the risk of loss in launching in spite of the avoidance criterion may be warranted.

It should be noted that the 28 accidents and incidents shown in Table 4 representing roughly one year of Air Force target operations would correspond to slightly more than one year of Navy operations.

2.4 DERIVED DATA FOR NAVY TARGETS

Table 5 gives the cumulative results of applying the cost benefit equation (Figure 2) to the Air Force data of Table 4. These values show the cost savings that would accrue over a 5-year operating period if corrective action were implemented on a Navy sample equal in size to the Air Force sample of Table 4.

In the equation of Figure 2, the investment in incident and accident investigation is assumed to be that expended over an investigating period of one year. Obviously, the 5-year cost savings do not grow linearly with the sample size of the incident and accident investigations, since as problems become identified the incident and accident rate will decrease.

For the BQM-34E, it can be expected that an incident-correction program would have a higher payoff in the early operational life of this model than was demonstrated in this analysis of BQM-34A sample data, since an investigation program can play a significant part in the maturation process during the early operational life. The MQM-74 may not provide sufficient recoverable data to permit comparable investigation benefits until such time as the ITCS with its telemetry capability is incorporated.

TABLE 5. COST-VS.-BENEFIT SUMMARY FOR BQM-34A ACCIDENT/INCIDENT INVESTIGATIONS

	Total	Total Excluding Item 11, Table 4
Reduction in Costs Without Avoidance Fixes	\$5,573,000	\$1,342,000
Cost* of Investigations (1 yr)	(251,000)	(251,000)
Net Savings Without Avoidance Fixes	5,322,000	1,091,000
Additional Cost Savings from Avoidance Fixes	694,000	690,000
Net Savings With Avoidance Fixes	\$6,016,000	\$1,781,000

*NOTE: Results are based upon one year of Navy operations, i.e.,

Number of accidents = 46 (operational losses in 1973, from Table 1)

Number of incidents = 46 x 4/3 (ratio of incidents to accidents in Air Force sample)

Cost of accident investigations = (Number of operational Navy losses in 1973 from Table 1) (Avg. number of hours per investigation) (Cost per manhour)

= 46 x 250 x \$18 = \$207,000

Cost of incident investigations = (Number of operational Navy losses in 1973) (Ratio of incidents to accidents in Air Force sample) (Number of manhours per investigation) (Cost per manhour)

= 46 x 16/12 x 40 x \$18 ≅ \$44,000

Total cost = \$251,000

3
FACTORS IN ESTABLISHING INVESTIGATION PROGRAM

3.1 GENERAL

Results of this study, as discussed in Section 2, revealed that for the level of target accident/incident investigation applied by the Air Force, the projected cost benefits for implementing corrective actions far outweigh the investment cost. An effort was then made to determine the best balance between the two elements of investment cost: the accident/incident investigation and the subsequent corrective action.

Examination of the Air Force data showed that the ratio between these two cost elements was rather heavily weighted toward the corrective-action process, which was on the average about three times as costly as the preceding accident/incident investigation. This suggests that, during the break-in period of a formal Navy program for investigating accidents and incidents relating to aerial targets, the manhours expended on the investigations could be even greater than was the case for the Air Force sample evaluated in this study without significantly affecting the overall cost of the corrective action.

Ultimately, when Navy personnel are indoctrinated and well trained in the investigative procedures, it is felt that the manpower expenditures for investigations could be substantially reduced. ARINC Research Corporation recommends the following as realistic allocations in an established program:

a. Incidents: 40 manhours
b. Accidents: 200 manhours

These figures could be modified as necessary after a period of investigation history is accrued. The estimates do not include the time expended by personnel actively involved in target operation, who can be considered to be available without additional budget expenditures. This same ground rule applies in the estimates given herein of Air Force expenditures.

In the case of accidents, the manpower expenditure during an investigation should be limited by only two factors — confidence in the assessment of cause, and

the amount of data remaining to be analyzed. An investigation should continue until the cause is isolated to a value exceeding 0.5 for parameter 3 in Table 1, or until the amount of data remaining to be reviewed appears to have insignificant impact upon the conclusions. These assessments should be made by a consensus of investigative team members. The assessment should also be subject to review by NAVMISCEN cognizant personnel and the next higher level of authority over the investigation.

It is not appropriate, within the scope of this analysis, to suggest a best general approach to corrective action. Corrective action alternatives for each investigation should, of course, be considered on their own merits as prescribed by the investigative analysis. The choice of alternatives may be influenced by such factors as:

a. Cost tradeoff
b. Constraints in contracting for the change
c. Possible phase-out plans for the target
d. Urgency of implementation due to potential hazard to human life. (The changes falling in this category often take precedence over the other alternatives.)

During the screening of incident and accident cases (see discussion, Section 2.3), care was taken to provide a conservative bias so as to permit conclusions to remain valid even with minor variances of the data inputs. Still, there remained a question in the analyst's mind regarding the sensitivity of the results to uncertainties in parameter 5 (the probability of recurrence given that no corrective action is taken). To explore this sensitivity, all values given in Table 4 for parameter 5 were decreased by a factor of 10 and the cost benefit analysis according to Figure 2 was repeated. The results indicated that a few cases changes from a positive to a negative benefit, but that the overall result remained positive by a significant margin.

3.2 NAVY-PECULIAR CONSIDERATIONS

Certain considerations peculiar to the use of Navy targets should be borne in mind when utilizing Air Force investigation procedures. These are:

a. <u>Higher utilization of targets by the Navy in a water recovery mode</u>. It is evident from Table 4 that a large number of Air Force target incidents are attributable to the recovery subsystem. A closer look reveals that many of these have to do with problems occurring at the point of touchdown at the

earth's surface. These incidents are certainly not representative of typical Navy operation. However, the Navy experiences a corresponding category of problems associated with water recovery – for example, sinking prior to pickup, damage during the pickup process, etc. A saltwater environment presents unique problems; however, the average Navy target experiences less than one water recovery prior to expenditure for other causes.

b. The difference in operational telemetry data available from the MQM-74A and -74C models as compared to the AQM-34A and -34E models. The only in-flight data that can be recovered for the former models when operating at sea is the radar plots from the AN/MSQ-5. This will deny isolation of flight control and command failure data to the degree required for corrective action identification. When ITCS conversion has taken place, this will not longer be a limitation.

3.3 INTER-NAVY SUPPORT CONSIDERATIONS

Several aspects of cooperative support within various agencies of the Navy will be required to make the recommended investigation program described in Section 4 effective. Perhaps the most important of these considerations has to do with the treatment of the expended target, or portions thereof which are recovered. Next is the treatment of the maintenance and operations records relating to a damaged or expended target. It is extremely important for the isolation of malfunction or cause that the recovered target or portions be handled as little as possible consistent with human safety in the vicinity. Maintenance and operational records surrounding the incident must also be preserved intact.

Investigation procedures must be well established and unitormly applied regardless of operating location. Reporting must be done to a prescribed format and distributed in a timely manner. The need for additional technical backup during an investigation must be identified quickly and support must be given immediately since time is of the essence. This is particularly true in water recoveries.

Obviously, the above considerations imply the cooperation of several agencies within the Navy, and will require documentation for reference as well as some amount of training to ensure the proper utilization of the investigation program.

4
RECOMMENDED ACCIDENT/INCIDENT INVESTIGATION PROGRAM

Based on the foregoing analysis, a program of accident/incident investigation is recommended. The basic program elements are definition, training, investigation, reporting, and corrective action monitoring. These elements are discussed in the paragraphs that follow.

4.1 DEFINITION

A special instructional document is required to define and authorize the accident/incident investigation process, particularly as it involves each target type and the many Navy agencies involved with the support of target operations. This instruction should preferably stand alone, without major reference to other documents. However it should not conflict with existing Navy instructions, such as OPNAVINST 3750.6J, unless sufficient cause can be cited.

An instruction covering target investigation could be prepared by NAVMISCEN for signature at a level that would assure the cooperation of the key agencies involved in the target operation. This would include support elements such as recovery boats, range and host-fleet operations, and maintenance crews.

The instruction should clearly state the objectives of target investigations. The primary motivation of such investigations is reduction in cost of operating and maintaining the target inventory. The safety-oriented objectives of manned aircraft investigations are not as applicable here.

4.2 TRAINING

Specialized accident-investigation training is available within the Navy at its Postgraduate School at Monterey.* This training would be appropriate for two or three key people from NAVMISCEN, and perhaps a nearby operational squadron such

*The individual to contact at that school is CMDR Bradbury.

as VC-3. Training at the operational unit level can be accomplished by this nucleus of formally trained people in either of two ways:

a. Bring representatives from each operating base to one location (preferably NAVMISCEN) to participate in an investigation exercise led by trained specialists, and with a combination of classroom and field activity; or

b. Rotate a two- or three-man specialist team sequentially through all operating locations to accomplish the equivalent objectives through on-site exercises.

Each of these approaches has advantages and disadvantages that the Navy could best weigh. A decision between them could be swayed by administrative convenience or other considerations.

4.3 INVESTIGATION

Although detailed investigation procedures should be left to the recommended Navy instruction, certain guidelines can be set down at this point:

a. One man should be designated from QA at each operational target base to be responsible for investigating and reporting on all incidents, as well as on accidents not involving or threatening personal injury or loss of life. For such accidents, the responsible person will utilize technical assistance at his discretion. An average of 150 manhours per accident of investigative time should be anticipated.

b. In all other accidents, the target safety office should be designated as the office of administrative responsibility. The responsible head of the accident investigation team should be carefully selected to avoid "self-inspection". If manned aircraft are involved, all investigation authority should be subordinate to any investigation established under OPNAVINST 3750.6J or other higher authority.

c. QA should be given authority and responsibility for impounding immediately all data bearing upon an accident. The impound period should be 5 working days for incidents, and 30 calendar days for accidents. The same subordination should be in effect when a team is established under higher authority.

d. The incident report should be filed by the responsible local QA person by message within 5 calendar days of occurrence. The data file should be

maintained locally for review indefinitely. The accident interim report should be filed by responsible local safety officer by message within 3 days of occurrence, and the final written report should be filed within 30 days. The distribution and format of reports should be consistent with existing Navy investigation instructions.

e. No changes to normal operations and maintenance procedures appear necessary initially to support these investigations.

f. Investigations should utilize AWCAP reports on UR status across the fleet inventory. Possible correlation of investigation findings with similar problems indicated from the AWCAP reports should be specifically included in the investigation reports.

4.4 REPORTING

To prevent the investigation program fron consuming undue attention and resources, it is recommended that the written report be reserved only for the final product of accident investigation, where team analysis and findings may be extensive. In all other cases, teletype messages should be used. The primary addressee for reports and messages should be NAVMISCEN.

4.5 GENERAL SUPPORT

An area of support that can benefit the overall accident/incident investigation program is the analysis of reports in relation to similar incidents, through the use of the TEMIS information system. The AWCAP software module specifically can be beneficial in determining whether a problem identified in one incident report is a random occurrence or is in fact chronic based upon similarity to past reports from other locations. This can be a very significant means of establishing a realistic priority for proposed corrective actions.

Another area of support that can be provided centrally through NAVMISCEN is specialized technical support in accident cases where local resources are not adequate to cope with the investigative analysis. Although this support would not be required in every case, there may be instances where circumstances warrant a backup capability. Examples of such a backup would be special tests, failure modes and effects analysis, and reliability analysis.